

CLAIMS

1. A method for repairing a turbine component, the method comprising the steps of:

cold gas-dynamic spraying powder material to buildup degraded areas on the turbine component; and

post-spray processing the turbine component to consolidate applied material and restore metallurgical integrity to the repaired turbine component.

2. The method of claim 1 wherein turbine component comprises a turbine blade.
3. The method of claim 2 wherein the turbine blade comprises a tip, and wherein the cold gas-dynamic spraying is performed on the tip.
4. The method of claim 2 wherein the turbine blade comprises a leading edge, and wherein the cold gas-dynamic spraying is performed on the leading edge.
5. The method of claim 2 wherein the turbine blade comprises a platform, and wherein the cold gas-dynamic spraying is performed on the platform.

6. The method of claim 2 wherein the turbine blade comprises a z-notch shroud, and wherein the cold gas-dynamic spraying is performed on the z-notch shroud.
7. The method of claim 1 wherein the step of post-spray processing the turbine component to consolidate applied material and restore metallurgical integrity to the repaired turbine component comprises performing a vacuum sintering on the turbine component after the step of cold gas-dynamic spraying particles.
8. The method of claim 7 wherein the step of performing a vacuum sintering comprises sintering in a vacuum for between 2 and 4 hours at temperatures of between 2050 degrees F and 2300 degrees F.
9. The method of claim 1 wherein the step of post-spray processing the turbine component to consolidate applied material and restore metallurgical integrity to the repaired turbine component comprises performing a hot isostatic pressing on the turbine component after the step of cold gas-dynamic spraying particles.

10. The method of claim 9 wherein the step of performing a hot isostatic pressing on the turbine component comprises pressing for between 2 and 4 hours at temperatures of between 2100 and 23000 degrees F and at pressures of between 10 and 30 ksi.
11. The method of claim 9 further comprising the step of performing a rapid cooling of between 45 and 60 degrees F per minute to a desired temperature level after the hot isostatic pressing.
12. The method of claim 1 wherein the step of post-spray processing the turbine component to consolidate applied material and restore metallurgical integrity to the repaired turbine component comprises a heat treatment of between 2 to 4 hours at temperatures of between 2000 and 2200 degrees F followed by a second heat treatment of between 16 to 24 hours at temperatures of between 1300 and 1800 degrees F.
13. A method for repairing a high pressure turbine component, the method comprising the steps of:
 - cold gas-dynamic spraying powder material to repair degradation in at least a portion of the high pressure turbine component;
 - vacuum sintering the high pressure turbine component;

performing a hot isostatic pressing on the high pressure turbine component;
and

heat treating the high pressure turbine component.

14. The method of claim 13 wherein the high pressure turbine component comprises a turbine blade.
15. The method of claim 14 wherein the turbine blade comprises a tip, and wherein the cold gas-dynamic spraying is performed on the tip.
16. The method of claim 14 wherein the turbine blade comprises a leading edge, and wherein the cold gas-dynamic spraying is performed on the leading edge.
17. The method of claim 14 wherein the turbine blade comprises a platform, and wherein the cold gas-dynamic spraying is performed on the platform.
18. The method of claim 14 wherein the turbine blade comprises a z-notch shroud, and wherein the particles are sprayed on the z-notch shroud.

19. The method of claim 13 wherein the step of performing a vacuum sintering comprises sintering in a vacuum for between 2 and 4 hours at temperatures of between 2050 degrees F and 2300 degrees F.
20. The method of claim 13 wherein the step of performing a hot isostatic pressing on the turbine component comprises pressing for between 2 and 4 hours at temperatures of between 2100 and 23000 degrees F and at pressures of between 10 and 30 ksi.
21. The method of claim 13 further comprising the step of performing a rapid cooling of between 45 and 60 degrees F per minute to a desired temperature level after the hot isostatic pressing.
22. The method of claim 13 wherein the step heat treating the high pressure turbine component comprises a heat treatment of between 2 to 4 hours at temperatures of between 2000 and 2200 degrees F followed by a second heat treatment of between 16 to 24 hours at temperatures of between 1300 and 1800 degrees F.

23. A method for repairing degradation on a turbine blade, the method comprising the steps of:

providing repair powder material;

mixing the repair powder material into a flow of gas, the gas at a temperature below a melt temperature of the repair powder material;

accelerating the repair powder material mixed into the flow of gas; and

directing the accelerated repair powder material to a target surface on the turbine blade, wherein the repair powder material deforms on the target surface to repair degradation on the turbine blade;

vacuum sintering the turbine blade for between 2 and 4 hours at temperatures of between 2050 degrees F and 2300 degrees F;

performing a hot isostatic pressing on the turbine blade for between 2 and 4 hours at temperatures of between 2100 and 23000 degrees F and at pressures of between 10 and 30 ksi; and

heat treating the turbine blade between 2 to 4 hours at temperatures of between 2000 and 2200 degrees F followed by a second heat treatment of between 16 to 24 hours at temperatures of between 1300 and 1800 degrees F.